

2020 Canadian Economics Olympiad

Please, read the following information carefully and follow the submission instructions

The Olympiad consists of two parts. Part 1 consists of 20 Multiple Choice questions and Part 2 consists of 20 numerical Short Answer questions. You do not need to show your work for part 1, but **must show your work for part 2**. The grading (with the exception of Question 14 of part 2) will be done as follows

- For MC questions (Part 1):
 - 3 points for correct answer
 - 1 point for non-answered question
 - 0 points for incorrect answer
- For Short Answer questions (Part 2)
 - Questions with wrong answers will not be graded and will receive a mark of zero.
 - Questions with correct answers will be graded. The maximum grade is 5 points per question. Penalties will be assigned for incomplete solutions.

All solutions (including formulas) must be typed and submitted as a single PDF file. If any graphs are required, they must be drawn using MS Word features, inserted as an Excel object, or scanned hand-drawn graphs must be inserted in appropriate place. Make sure you clearly identify each question number and your final answer. No multi-file submissions will be accepted.

The PDF file must be named as Lastname_Firstname_Firstletterofthenameofyourcity.pdf. For example, if you are Doug Ford from Toronto, the file name should be Ford_Doug_T.pdf. To avoid transmission problems, make sure the size of your PDF file does not exceed 5MB. Please include your full name, email, city, province, and high school in your submitted solutions.

All solutions must be submitted by 11pm EST on August 8, 2020 by email to canadian.economics.olympiad@gmail.com

You are allowed and encouraged to use any online and offline resources during the contest, but you are not allowed to seek help from other people (either in-person or via phone, text, e-mail, online posts, and other forms of communication). You may not ask questions (either directly or indirectly) related to this contest or any economics, finance, or accounting topics before the official end of contest at 11pm. This includes in person, phone, text, e-mail, and any online communication and posts.

If you have any questions to the organization committee during the contest, please, email to ceo.oec.questions@gmail.com

You may find the following formulas useful:

$$x + x^2 + \dots + x^n = \frac{x - x^{n+1}}{1 - x}$$

$$\frac{1}{1+r} + \frac{1}{(1+r)^2} + \dots + \frac{1}{(1+r)^n} = \frac{1}{r} \left(1 - \frac{1}{(1+r)^n} \right)$$

For $|x| < 1$: $x + x^2 + \dots = \frac{x}{1-x}$

For $r > k \geq 0$: $\frac{1}{1+r} + \frac{1+k}{(1+r)^2} + \frac{(1+k)^2}{(1+r)^3} + \dots = \frac{1}{r-k}$

A function $f(x) = a + bx - x^2$ is maximized at $x = b/2$

Part 1: MC questions. You do not need to show your work

1) Consider a person who has \$M to spend on products X and Y. Assume the person's utility function $u(X,Y)$ satisfies the non-satiation and decreasing marginal utility requirements. If the price of X decreases while neither the price of Y nor the person's budget of \$M changes, which of the following MUST be true?

- A) The consumption of X will decrease, and consumption of Y will increase
- B) The consumption of X will decrease while consumption of Y will stay the same
- C) The consumption of both X and Y will decrease
- D) The consumption of X will decrease while consumption of Y may decrease, increase, or stay the same
- E) None of the above

2) Consider an economy with 10 different products in which all people have the same budget of \$M and the same utility function that satisfies the non-satiation and decreasing marginal utility requirements. For a given price level and personal budget, what can we say about the number of inferior products in the economy?

- A) It must have no inferior products
- B) It must have no more than 1 inferior product
- C) It must have exactly 5 inferior products
- D) It must have no more than 9 inferior products
- E) None of the above

3) Consider a person who has \$1000 to spend on products X and Y. Assume the person's utility function $u(X, Y)$ satisfies the non-satiation and decreasing marginal utility requirements. If the person's budget increases to \$2000 while neither the price of X nor the price of Y changes, which of the following is correct:

- A) If X and Y are complements, their consumption MUST increase
- B) If X and Y are substitute, their consumption MUST increase
- C) If both X and Y are normal goods, their consumption MUST increase
- D) Both (A) and (B)
- E) Both (A) and (C)
- F) Both (B) and (C)
- G) All (A), (B), and (C) are correct
- H) None of the above

4) What should be the short-run decision of the firm with the minimum Average Variable Costs of \$10 per unit and the minimum Average Total Costs of \$15 per unit, assuming it operates in perfectly competitive environment and observes that the market price on its output decreases from \$17 to \$12 per unit?

- A) Shut down the production and exit the industry
- B) Shut down the production but keep its production facilities waiting for the price to go above \$15 again
- C) Produce at the quantity that makes its Marginal Costs equal to the current market price
- D) Produce the same quantity as before the price change
- E) Increase production to gain larger share of the market

5) Which of the following is the best example of a natural monopoly?

- A) A residential power supply company
- B) A farm
- C) A violin teacher giving private lessons
- D) Oil extraction company
- E) Oil refinery

6) Which of the following is the best example of price discrimination?

- A) Airlines charging extra for seat selection
- B) 15% student discount at restaurants
- C) Grocery stores marking down products near their expiration date
- D) A 12-pack of Coca-Cola priced lower than the price of 12 individual Coca-Cola cans
- E) Different stores charging different prices for identical product

7) What is the most likely effect of a Bank of Canada target overnight interest rate decrease on the bond prices? (Note: “discount” bonds are the bonds selling at the price below their face value while “premium” bonds are bonds selling at the price above their face value)

- A) The price of discount bonds will most likely increase while the price of premium bonds will most likely decrease
- B) The price of discount bonds will most likely decrease while the price of premium bonds will most likely increase
- C) All bond prices will most likely increase
- D) All bond prices will most likely decrease
- E) The Bank of Canada target overnight interest rate change will, most likely, have no effect on bond prices

8) With upward supply and downward demand curves, an increase in HST (or, for provinces without HST, and increase in GST or PST) will most likely:

- A) Decreases producers, but not consumer surplus
- B) Decreases consumer, but not producer surplus
- C) Decreases both producer and consumer surplus but the government revenue may be sufficient to keep Deadweight Loss unchanged
- D) Decreases both producer and consumer surplus, and increases the Deadweight Loss
- E) None of the above

9) Two firms compete in a duopolistic market over N years. Each year $t=1,2,\dots,N$, firms can choose “low” or “high” production. If both firms choose “high” production, both firms’ profits are \$1. If both firms choose “low” production, both firms’ profits are \$3. If one firm chooses “low” production while the other chooses “high” production, the firm with low production earns \$0 while the firm with high production earns \$4. At each time $t=1,2, \dots, N$, each firm makes a decision independently. Assume that firms know how much profit every firm made in the past. The discount factor is $0 < \rho < 1$, i.e., each \$1 made at time t is equivalent or ρ^{t-1} made at time 1. It is also known that at time $N+1$, the firm’s product will be obsolete, and no firm can earn any profit beyond time N . Under which condition will both firms choose “low” production at $t=1$?

- A) Always
- B) When ρN is sufficiently high
- C) When ρN is sufficiently low
- D) When ρ/N is sufficiently high
- E) When ρ/N is sufficiently low
- F) Never

10) Two firms compete in a duopolistic market during a single period. Each firm can choose to produce either 1 or 2 units. The firms make their production choice independently. Firm #1 uses more cost-effective technology and its production costs are \$1000 per unit. The production costs of firm #2 is \$2000 per unit. The demand function is given by $P(2) = \$7,400$; $P(3) = \$5,000$; $P(4) = \$4,000$. What will be the equilibrium production?

- A) Firm #1 will produce 1 unit and firm #2 will produce 2 units
- B) Firm #1 will produce 2 units and firm #2 will produce 1 unit
- C) Both firms #1 and #2 will produce 1 unit each
- D) Both firms #1 and #2 will produce 2 units each
- E) There is no pure strategy equilibrium in this game

11) Consider a competitive market with sales taxes. The demand is given by $Q_D=100-P$ and the supply is given by $Q_S=3P$. A sale tax of \$4 per unit is imposed on consumers. The government wants to eliminate taxes. Instead, the government wants to introduce either a price ceiling or a price floor in such way that the consumer surplus is not affected. What should it do?

- A) Set a price ceiling at \$22
- B) Set a price ceiling at \$25
- C) Set a price ceiling at \$26
- D) Set a price floor at \$22
- E) Set a price floor at \$25
- F) Set a price floor at \$26
- G) None of the above

12) What is the effect of price discrimination in a monopolistic market?

- A) It increases consumer surplus
- B) It increases social surplus
- C) It reduces total output
- D) It reduces producer surplus
- E) None of the above

13) Which of the following transactions will increase Canadian Gross Domestic Product?

- A) Someone from Alberta purchased a jacket produced in Ontario
- B) A bakery in Toronto purchased a new oven that will increase its output of pies
- C) A restaurant in Vancouver purchased flour to bake bread for its customers
- D) All of the above
- E) A and B only

14) Ed and Ben are American artists selling their paintings to a Canadian store. Ed stores the money he earns under his mattress, but Ben decides to invest his money in Government of Canada bonds. Who is generating a capital inflow for Canada?

- A) Ed
- B) Ben
- C) Both Ed and Ben
- D) Neither Ed nor Ben
- E) Not enough information to determine

15) When the Federal Reserve buys US Treasury Bonds from a depository institution, what happens to the Fed's assets and liabilities?

- A) Both assets and liabilities increase
- B) Both assets and liabilities decrease
- C) Both assets and liabilities are unchanged
- D) Assets increase, liabilities decrease

16) Which of the following happens when inflation rate falls from 5% to -3%?

- A) Debtors and creditors experience a decline in their real wealth
- B) Debtors and creditors experience an increase in their real wealth
- C) Debtors would experience an increase in the real wealth, but creditors would see a decline
- D) Debtors would experience a decline in the real wealth, but creditors would see an increase
- E) Debts and creditors experience no impact to their real wealth

17) Which of the following is an unconventional form of monetary policy that has immediate and direct impacts on the Federal Reserve's balance sheet?

- A) Quantitative Easing (QE)
- B) Forward Guidance
- C) Open Market Operations
- D) A and B only
- E) B and C only

18) The federal funds rate is the rate banks charge when lending to each other overnight. Since 2008, the Federal Reserve – the central bank in the United States – has set the federal funds rate through:

- I) Open Market Operations (OMO)
- II) Interest on Excess Reserves (IOER)
- III) Overnight Reverse Repurchase Agreement Facility (ONRRP)

- A) I only
- B) I and III only
- C) I and II only
- D) III only
- E) I, II, and III

19) In 2020, a Roots store sold a pair of socks manufactured in Ontario to an Ontario resident at a Toronto store. How does this transaction impact Canada's 2020 national income accounts? (Note: C = consumption of goods/services, I = gross investment, G = government purchases, NX = net exports)

- A) C and I increase; G and NX are unchanged
- B) C increases; I decreases; G and NX are unchanged
- C) I increases; C , G , and NX are unchanged
- D) C and G increase; I and NX are unchanged
- E) None of the above

20) Given that a production function $Y = F(K, L)$ has Constant Returns to Scale (CRS) when $z \cdot Y = F(z \cdot K, z \cdot L)$, which of the following equations displays CRS? (Note: K denotes capital, L denotes labour)

- A) $2K + L$
- B) $\sqrt{K} + L$
- C) $\sqrt{K} + \sqrt{L}$
- D) A and B only
- E) B and C only

Part 2: Short-answer questions. You must show your work and clearly identify your answer.

Problem 1: A monopolist with a cost function $C(Q) = Q^2$ operates in a market with the demand function $Q = 100 - P$. What is the monopolist's optimal production level?

Problem 2: XYZ Inc. is expected to pay \$10 in dividends one year from now, \$12 in dividends two years from now, and \$8 in dividends three years from now. Four years from now, it will be liquidated and pay liquidation dividends of \$25. The required return on XYZ investment is 10%. Find XYZ's stock price.

Problem 3: XYZ Inc. expects to pay \$5 each year for 3 years and \$10 dividend 4 years from now, after which time the dividends will increase at the rate of 10% per year (i.e., 5 years from now the dividend will be $\$10 * 1.1 = \11 , 6 years from now it will be $\$11 * 1.1 = \12.10 , etc.). The required return on investment in XYZ is 15%. Find the capital gain yield for XYZ stock during the first year (assume all rates are annually compounded).

Problem 4: Two firms compete on duopolistic market with the demand function $Q = 100 - P$. The first firm has a marginal cost of \$4 per unit of output while the second firm has a marginal cost of \$16 per unit of output. The firms choose their production level simultaneously and independently on each other. How much the first firm will produce in equilibrium?

Problem 5. Consider a competitive market where the demand is given by $Q_D = 100 - P$ and the supply is given by $Q_S = 3P$. If the government introduces a \$4 per unit sales tax, what is the deadweight loss?

Problem 6: Alex and Bob jointly own a firm that is currently valued at \$1000. It is a partnership and they cannot sell it. But they do not get along with each other. They decided that one of them should “buy” the other person’s share and keep the firm. They will do as follows:

At $t=1$, Alex offers a certain payout X_1 to Bob. If Bob accepts, Alex keeps the firm. Alex’s profit will be $\$(1000 - X_1)$ and Bob’s profit will be $\$X_1$. However, if Bob rejects, they will wait for a year, at which point the firm will not operate and its value will drop to \$500.

At $t=2$ (if no offer was accepted yet), Bob offers a certain payout X_2 to Alex. If Alex accepts, Bob keeps the firm. Bob’s profit will be $\$(500 - X_2)$ and Alex’s profit will be $\$X_2$. However, if Alex rejects, they will wait for another a year, at which point the firm will not operate and its value will drop to \$250.

At $t=3$ (if no offer was accepted yet), Alex offers a certain payout X_3 to Bob. If Bob accepts, Alex keeps the firm. Alex’s profit will be $\$(250 - X_3)$ and Bob’s profit will be $\$X_3$. However, if Bob rejects, they will wait for another year, at which point the firm will not operate and its value will drop to \$100.

At $t=4$ (if no offer was accepted yet), Bob offers a certain payout X_4 to Alex. If Alex accepts, Bob keeps the firm. Bob’s profit will be $\$(100 - X_4)$ and Alex’s profit will be $\$X_4$. However, if Alex rejects, they will wait for another year, at which point the firm will be worthless and both Alex and Bob end up with \$0.

There is no time discounting. How much should Alex offer Bob at $t=1$ if everyone wants to maximize his own profit?

Problem 7: You just took a \$500,000 mortgage, which you are going to repay by making equal monthly payments of \$3,221.51 for 25 years starting next month. The monthly interest rate (compounded monthly) is 0.5%. During the first 5 years, you made several additional prepayments, which, combined, reduced your mortgage amortization period by 2 years. What will be the balance on your mortgage 5 years from now (right after you make your 60th payment)? If you believe that the provided information is not sufficient to find this balance, say so and briefly explain why.

Problem 8: You want to buy a car. There are two financing options available:

Option A: \$300 monthly payments for 5 years starting next month with no down payment

Option B: \$350 monthly payments for 4 years starting exactly 13 months from now with a down payment of $\$X$ due today.

If you have no budgetary constraint and can invest and borrow at risk-free interest rate of 1% per month (with monthly compounding), find the amount of down payment $\$X$ that makes you indifferent between two options.

Problem 9: You just won a lottery that pays you \$20,000 forever each other year starting 3 years from now (i.e. it pays you \$20,000 at $t=3, 5, 7, \dots$). Alternatively, you can take a lump-sum of \$X today (at $t=0$). If the annual interest rate is 6% (annually compounded), what value of X makes you indifferent between two options?

Problem 10: A person with utility function $U(X, Y) = \sqrt{XY}$ and a total of \$1,000 to spend faces the prices of $P_X = \$20$ and $P_Y = \$5$. How much of product X will this person buy?

Problem 11: An owner needs to hire an employee. The employee may choose a low ($e=0$) or high ($e=1$) level of effort and the owner cannot observe the effort level. The firm's profit (before wage to the employee is paid) can be either $\pi = \$100$ or $\pi = \$300$. If employee chooses low level of effort, the probability that $\pi = \$100$ is equal to 75%. If employee chooses high level of effort, the probability that $\pi = \$100$ is equal to 25%. The employer can observe the profit and set the wage as a function of profit $w(\pi)$. The employee's utility function depends on wage and effort and is given by $U(w, e) = \sqrt{w} - 4e$. Negative wages are not allowed. If the employer wants to maximize his expected profit (after paying the employee) what should be the wage when the realized profit is $\pi = \$300$?

Problem 12: Bank AAA uses quarterly (i.e. every 3 months) compounding while bank BBB compounds interest every 4 months. If bank AAA offers you 12.56% APR, what APR should bank BBB offer you to make you indifferent between two offers? Keep at least 6 decimal digits while performing your calculations. Round your final answer to 4 decimal digits.

Problems 13 to 15 are based on the following information

A company named DEF resells construction tools in Canada. They began their operation on July 1st, 2020. The transactions described below were made during the month of July. Part marks for incorrect answers may be considered for Question 14.

- 1) Shareholders contributed \$135,000 for common stock of DEF.
- 2) DEF paid \$50,000 in advance and \$100,000 on account for merchandise for resale due in four months or less. To store this equipment, they also signed a lease on July 1st for warehouse and offices, paying \$32,000 in cash in advance for an eight-month occupancy.
- 3) Merchandise that had originally cost \$130,000 was sold for \$200,000 on account.
- 4) Additional payments of \$50,000 were made to suppliers. Collections of \$120,000 were made from customers.
- 5) Paid employees \$6,000 in wages for the month on the last day of July.

Problem 13: What is the cash balance at the end of the month of July?

Problem 14: What is the total assets balance at the end of the month of July? Note that the question asks for total assets, not for net assets.

Problem 15: What is the net income in July?

Problem 16: The Republic of Zunni has 200,000 employed workers, 2000 frictionally unemployed workers, 5000 structurally unemployed workers, 1000 cyclically unemployed workers, and 2000 people not in the labour force. What is the unemployment rate (in %) rounded to two decimal digits?

Problem 17: Ocena is a country with a long-run real GDP of 1200. The government has a balanced budget, where $G = T = 400$ and G represents government spending while T represents taxes. Households have a long-run consumption equation of $C = 0.5(Y - T) - 80r$, based on income net of taxes (T) and interest rates (r). Firms' long-run capital investment is modeled by $I = 500 - 80r$. Long-run net exports dependent on exchange rate (\mathcal{E}) can be written as $50 + 100\mathcal{E}$. Long-run net capital outflow (NCO) can be represented as $NCO = 300 - 80r$. Calculate the equilibrium exchange rate (\mathcal{E}).

Problem 18: Kathy is a Canadian resident is visiting United States and wants to purchase a new jacket from Hobro Outfitters, a store that operates in both Canada and the US. Assuming that there are no transport costs to bringing the jacket back home, Kathy wants to know if there is a difference in real price between the same jacket in Canadian versus American store locations. The exchange rate is 0.75 US dollars/Canadian dollar. The jacket costs 230 Canadian dollars and 160 US dollars. Solve for the real exchange rate (RER) rounded to 2 decimal points. Write one sentence where you use the RER value to explain whether Kathy should buy the jacket from US or Canadian store.

Problem 19: There are two secluded islands that trade with one another: island A and island B. They produce pineapples and coconuts. Let P be the number of pineapples produced and C be the number of coconuts produced. The Production Possibilities Frontier for island A is modeled by $3P+4C=240$ and the Production Possibilities Frontier for island B is modeled by $5P+3C=211$. Assuming that all people on both islands A and B consume in a fixed proportion of 2 pineapples to 1 coconut, find the total number of pineapples across both islands.

Problem 20: Bank Adamo is one of three banks in a small country named Villion. In Villion, all three banks have the same amount of reserves in dollars at the Central Bank. The Central Bank has a reserve total of \$300, where each bank has a reserve ratio of 10% and \$50 in excess reserves. Assume that bank reserves and loans make up total assets and deposits make up total liabilities. If Bank Adamo has a net worth of \$200, calculate the value of Bank Adamo's deposits.